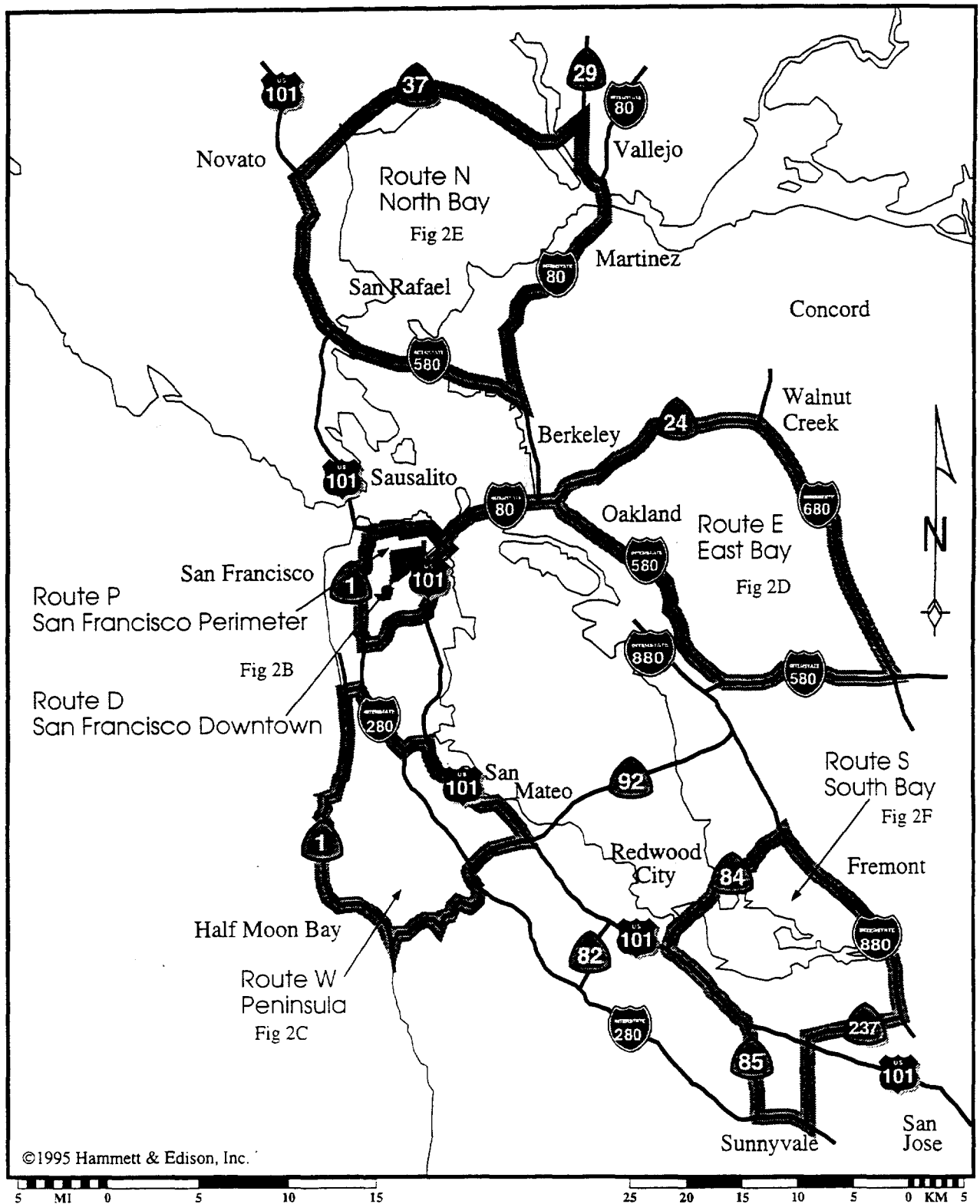
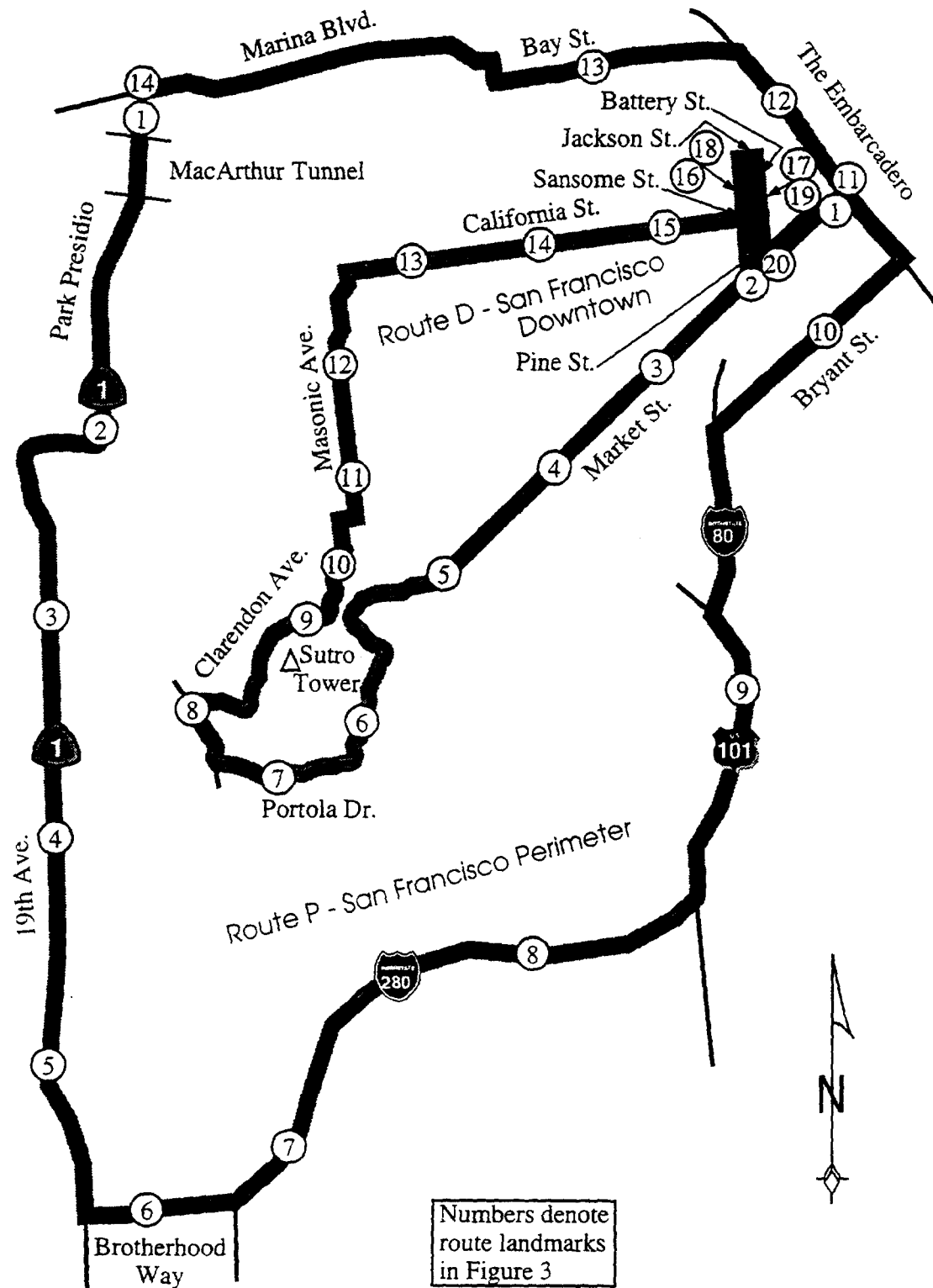


"Long Path" Test Routes

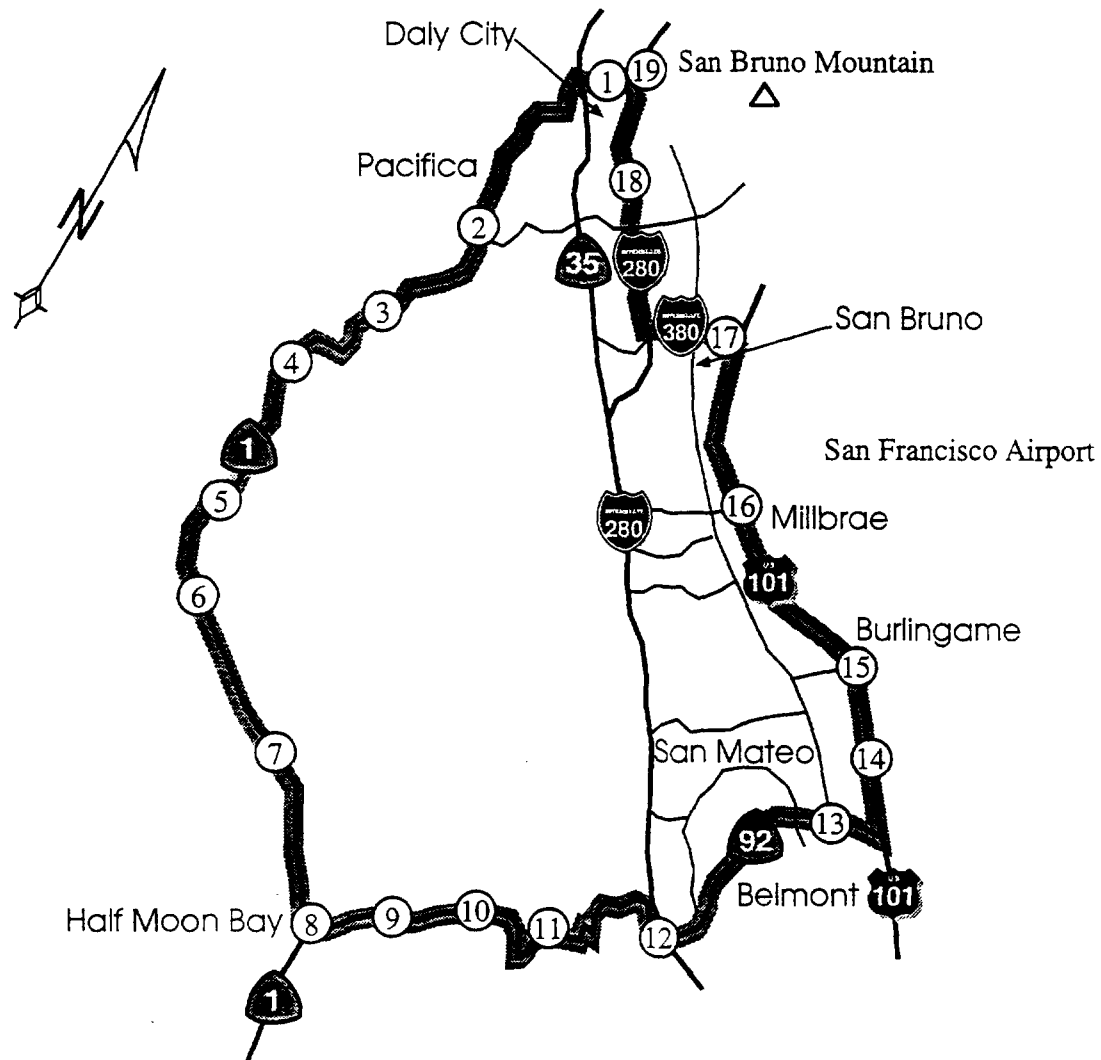


"Long Path" Test Routes  
Routes D & P • San Francisco



"Long Path" Test Routes

Route W • San Francisco Peninsula



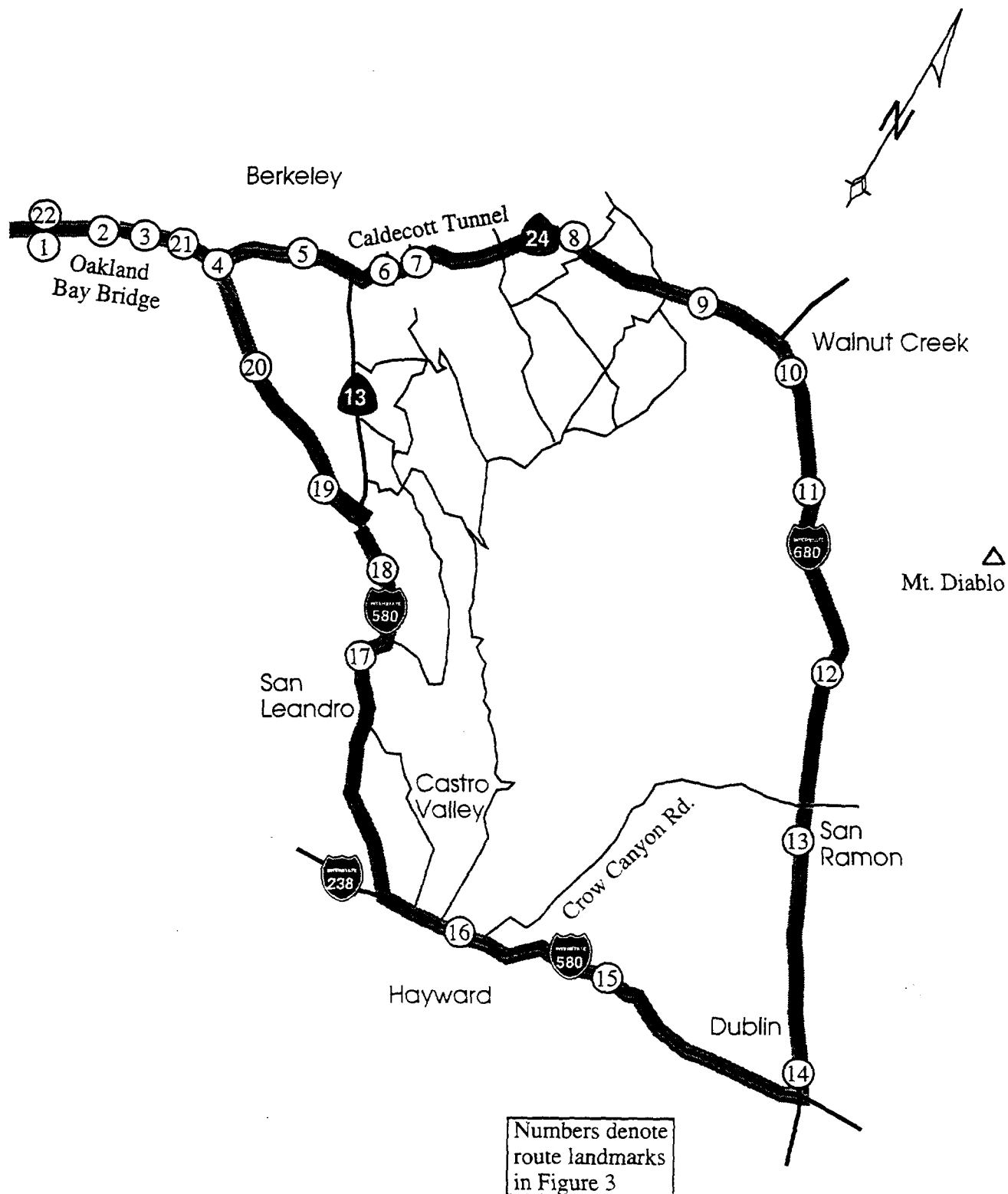
Numbers denote  
route landmarks  
in Figure 3



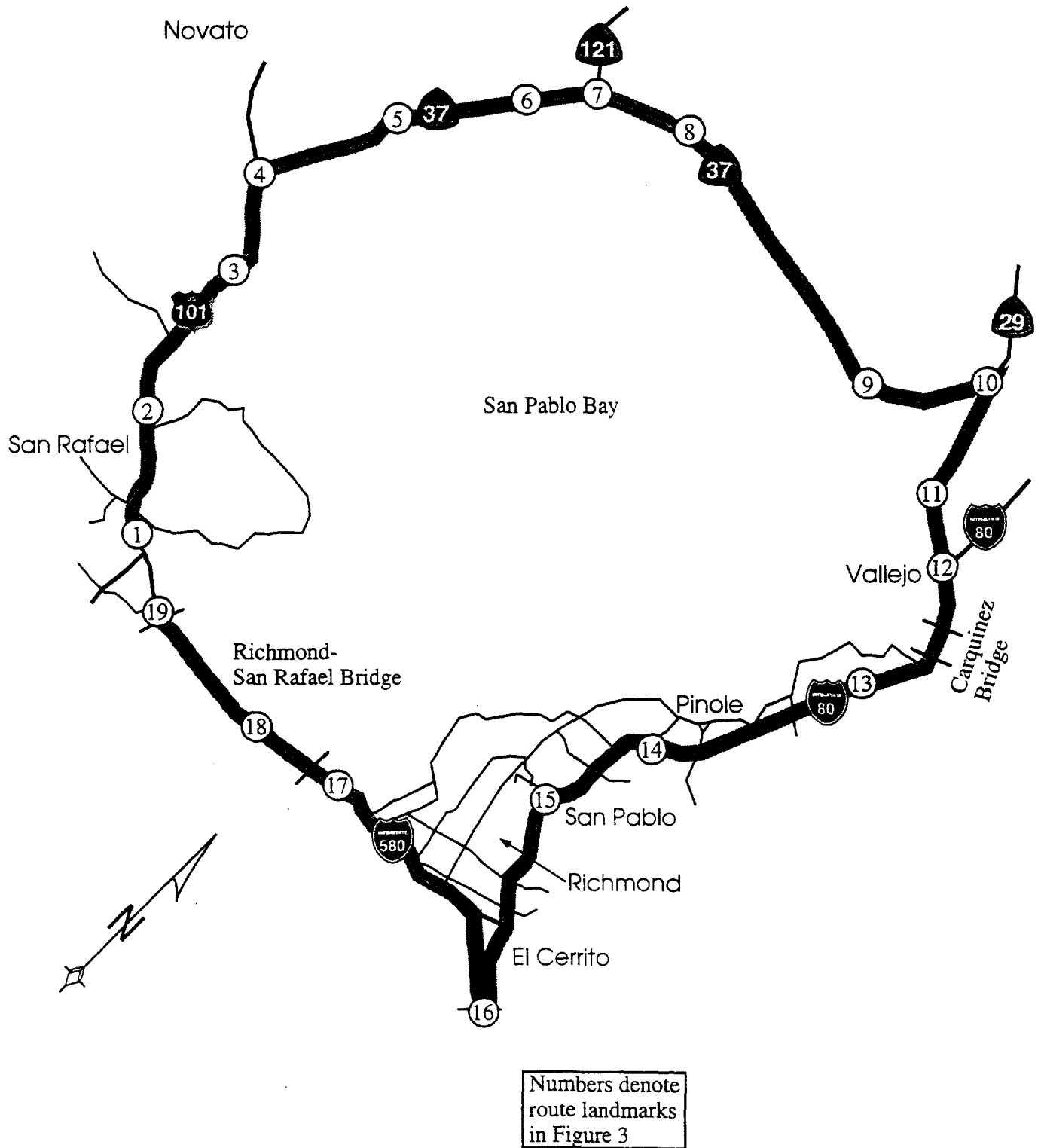
**HAMMETT & EDISON, INC.**  
CONSULTING ENGINEERS  
SAN FRANCISCO, CA

"Long Path" Test Routes

Route E • East Bay

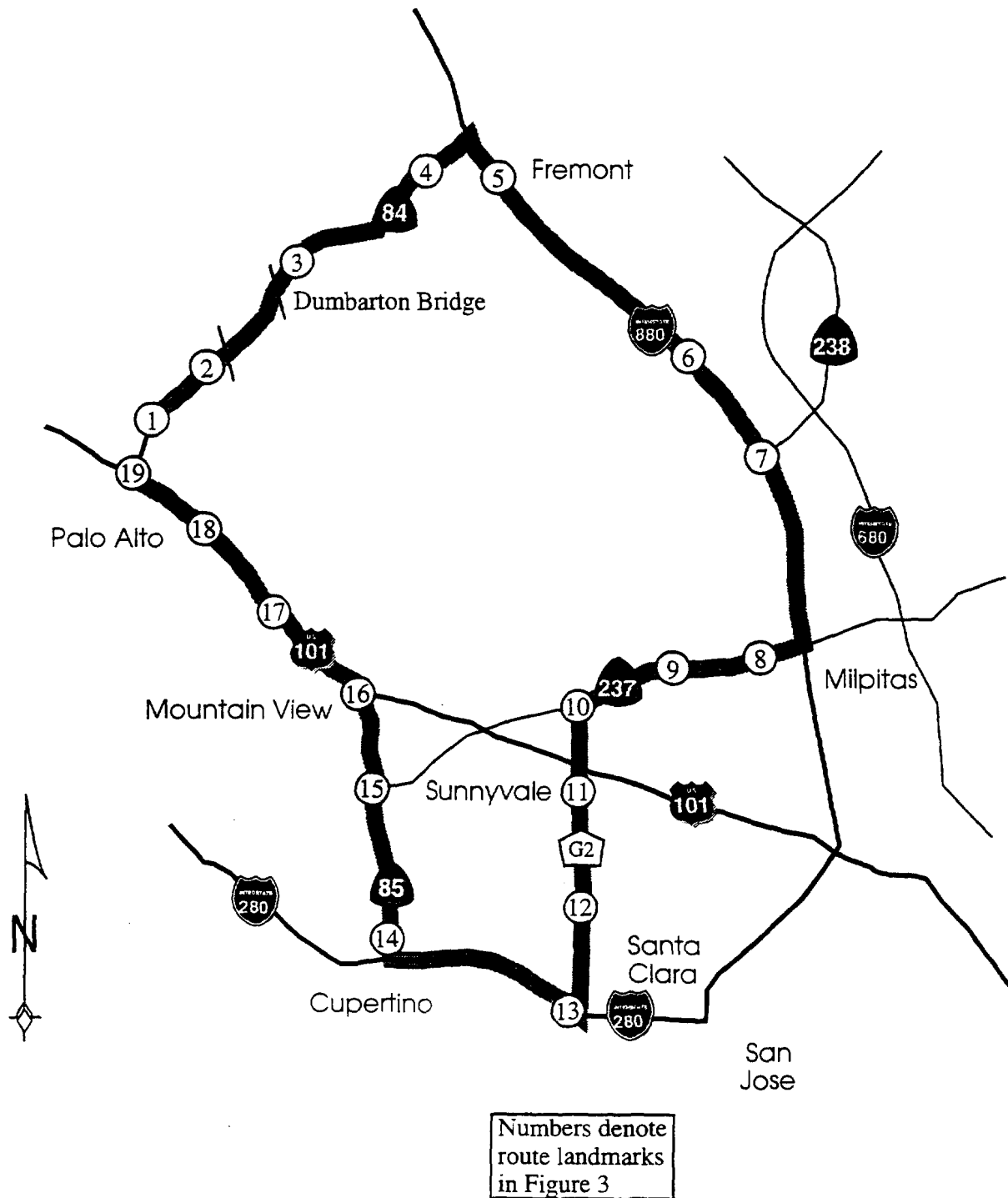


"Long Path" Test Routes  
Route N • North Bay



"Long Path" Test Routes

Route S • South Bay



**"Long Path" Test Routes  
Landmark Descriptions**

**Route P**

<u>Landmark Number</u>	<u>Environment Designator</u>	<u>Landmark Description</u>
1	FSD	Call box on 19th before tunnel
2	HSD	Intersection of 19th & Fulton
3	HSL	Intersection of 19th & Noriega
4	HSL	Intersection of 19th & Vincente
5	FUM	Intersection of 19th & Holloway
6	FUM	Arch stop light
7	FUL	Stop light under BART tracks before 280 onramp
8	HUL	"I-280 Downtown" sign at Alemany exit
9	FUL	"I-80 Bay Bridge/Downtown" sign on overpass
10	HUL	2nd Street stop light
11	FUL	Clock tower at World Trade Center
12	FUM	Stop light at Battery
13	HUL	Stop light at Columbus & Bay
14	END	"19th Avenue Exit" sign

**Route D**

1	FDL	Left turn on Market from Steuart (center of intersection)
2	FDL	"American Savings Bank" blue and white sign on building
3	FDL	Red and White Levi's "House of Blue Jeans" sign on building past 5th
4	HDL	Central Skyway (Hwy 101) overpass
5	HUM	Intersection of Castro, 17th and Market
6	HUM	Pedestrian overpass after Argent and Market
7	HUD	Right turn on Woodside Avenue
8	HSD	Blank yellow diamond sign at right turn on Clarendon
9	HUM	Mailbox past intersection of Clarendon and Twin Peaks
10	HUM	"15 MPH" turn sign at corner of Clifford Terrace and Ashbury
11	HUM	"No Left Turn 4-7pm Everyday" sign at Fell and Masonic
12	FUL	"Recycling Center" sign at Anza/O'Farrell and Masonic
13	HUL	Stop light at intersection of Scott and California
14	HUL	"Trucks use Van Ness Avenue" sign at California and Gough
15	HDL	Blue and White "Parking" sign marking garage at California and Taylor
16	FDL	Federal Reserve Bank of SF after Sacramento and Sansome (statue) (1st)
17	FDL	Pedestrian walkway over Battery Street before Sacramento (1st)
18	FDL	Federal Reserve Bank of SF after Sacramento and Sansome (statue) (2nd)
19	FDL	Pedestrian walkway over Battery Street before Sacramento (2nd)
20	END	Entrance to intersection of Market and Battery



## “Long Path” Test Routes Landmark Descriptions

### Route W

Landmark Number	Environment Designator	Landmark Description
1	HSM	I-280 to Hwy 1 South—Clarinada Blvd exit sign
2	HSM	“End Freeway” sign at Sharp Park Blvd
3	MRD	Linda Mar Drive stop light
4	MRM	Devil’s Slide winding road (S) sign
5	HSM	Montara Chart House restaurant
6	FSM	Half Moon Bay/San Mateo Airport entrance sign
7	FSM	Gin Wan Chinese restaurant
8	VSD	Junction of Hwy 1 & Hwy 92 east
9	VRD	“Obester Winery” sign
10	MRM	“Lombardi Spring” well sign
11	MRD	“S” Sign after Hwy 35 junction
12	HSM	I-280 overcrossing at 92—280 north sign at onramp
13	FUM	“El Camino Real North/South” sign
14	FUM	“3rd Ave Next Right” sign
15	FUL	Peninsula Ave overpass
16	FUL	Millbrae Ave overpass
17	FSM	“San Bruno/El Camino Real” exit sign after 380 onramp
18	HSM	“Daly City” city limit sign
19	END	“Hwy 1 Pacifica/Mission Street Exit” sign

### Route E

1	FBN	“50 MPH” sign immediately after last SF entrance to I-80 (Battery)
2	FBN	“15 MPH” sign with U-shaped arrow at entrance to tunnel
3	FUL	Hwy 80/580/680 direction sign immediately after bridge
4	FUL	“Walnut Creek 24” sign at end of entrance ramp
5	HSM	“Tunnel Road 1½ mi” sign
6	FTN	Entrance to Caldecott Tunnel
7	HRM	End of Caldecott Tunnel
8	HRD	“St. Stephens Road/Hidden Valley Road Next Exit” sign
9	HRM	“Pleasant Hill Rd 1 mi/Jct 680 2¼ mi” sign
10	HRM	“So Main Street Next Exit” sign
11	HRM	“Stone Valley Road East/West” sign
12	FRM	Overpass after Sycamore Valley Road exit
13	FRM	Overpass with “Bollinger Canyon Road Next Exit” sign
14	HRM	“Oakland/Stockton 580” sign above beginning of onramp to 580
15	HRM	“Eden Canyon Road/Palomares Road ¾ mi” sign
16	HSM	“Castro Valley Next Right” sign
17	HSM	“Oakland Zoo-Park/Oakland Airport Next Right” sign
18	HSD	Large green water tank on hill immediately past Keller Avenue exit
19	FSM	Overpass with “Coolidge/Fruitvale Avenue” and “Bay Bridge” signs
20	FUM	Overpass with “Lakeshore/Grand Avenue/Harrison Street” sign
21	FBN	“Toll Crossing ½ mi Auto Toll \$1.00” sign
22	END	Railing over west end of Bay Bridge





**“Long Path” Test Routes  
Landmark Descriptions**

**Route N**

<u>Landmark Number</u>	<u>Environment Designator</u>	<u>Landmark Description</u>
1	HUM	Central San Rafael Exit sign (north end of exit lane)
2	HSM	Frank Lloyd Wright Building at Marin Center Sign
3	HSM	Alameda del Prado overpass
4	FRM	Intersection of Highway 101 and Highway 37, double arrow sign
5	FRL	Marin/Sonoma County line on Bridge
6	FRL	Lakeville Highway stop light
7	FRL	Highway 121 stop light
8	FRL	“Solano County Line” sign
9	FSL	“Welcome to Vallejo” sign
10	HUM	Intersection of Highway 37 and Highway 29 at “T” sign
11	HSM	Veer left at Curtola Pkwy
12	HSM	“I-80 Freeway Entrance” sign
13	HEM	“Hercules Next Two Exits” sign
14	HSM	First Appian Way overpass
15	HSM	“San Pablo City Limit” sign
16	HSM	“Freeway Entrance” sign at onramp to 580 north from Central Avenue
17	FBN	“Toll Crossing Entrance 1/4 Mile” sign
18	FBN	“Marin County Line” sign on bridge
19	END	I-580 and Highway 101/Exit sign for Sir Francis Drake

**Route S**

1	FSM	“Sun Microsystems” sign at intersection of 84 and Willow
2	FBN	“Dumbarton Bridge Toll Crossing Entrance” sign
3	FRL	South KGO tower (closest to 84)
4	FSM	Overpass with “Newark Blvd/Ardenwood Blvd Next Right” sign
5	FSM	Railroad overcrossing past Thornton Avenue exit
6	FSL	Overpass after Auto Mall Parkway exit
7	FSL	Overpass with “Dixon Landing Road 1 <sup>3</sup> / <sub>4</sub> mi” sign
8	FSL	Overpass with “McCarthy Blvd/Ranch Dr” sign past McCarthy Ranch mall
9	FSL	Overpass past North First Street exit
10	FSM	Hwy 237/Milpitas Freeway Entrance sign on Lawrence Expwy (overpass)
11	FSM	“Fry’s Electronics” sign on Lawrence
12	FSM	“El Camino Real Right Lane” sign on Lawrence
13	FSM	“North 280 Freeway Entrance” sign
14	FSM	Overpass with “Fremont Ave/Los Altos <sup>3</sup> / <sub>4</sub> mi” sign on 85
15	FSM	“Mountain View City Limit” sign on 85
16	FSM	North 101 San Francisco” sign at Moffett Blvd exit
17	FSM	Overpass after San Antonio Road exit/Palo Alto city limit
18	FSM	“East Palo Alto City Limit/San Mateo County Line” signs
19	END	“Willow Rd/Fremont East 84” sign

**"Long Path" Test Routes  
Landmark Descriptions**

**RF Environment Designators**

RF Environment Designators are three-letter codes representing typical landscape features encountered along each section of a long path test route. The code associated with each landmark pertains to the segment of the route beginning at that point and continuing to the next mark; for the last landmark on a path the designator "END" is always used. Where one path section contains very different landscape features, the codes denoting features typical of the majority of that section are used. The codes used are as follows:

**First Letter - Terrain**

F	Flat	Little or no change in elevation
H	Hilly	Gradual changes in elevation
M	Mountainous	Steep changes in elevation
V	Valley	Roadway between regions of consistently greater elevation

**Second Letter - Urbanization**

R	Rural	Open space with occasional buildings typically less than 3 stories tall
S	Suburban	Some space between buildings typically less than 3 stories tall
U	Urban	Many closely-spaced buildings less than 10 stories tall
D	Dense	Many closely-spaced buildings 10 stories tall or greater
B	Bridge	No urbanization; roadway above water
T	Tunnel	No urbanization; roadway underground

**Third Letter - Foliage**

N	None	No foliage; roadway above water or underground
L	Light	Grasses and low bushes, occasional short trees
M	Moderate	Bushes and stands of short trees, occasional tall trees
D	Dense	Many closely-spaced, tall trees

## Electronic Industries Association

### "Long Path" Test Routes - Qualitative Information

The long path test routes described in Figures 1 and 2 were selected to allow system evaluation under differing terrain and line-of-sight conditions. Described below are some of the qualitative characteristics of each proposed route.

Route P - San Francisco Perimeter: This route circles virtually the entire City of San Francisco. It includes travel on popular commute routes and through popular tourist areas. The northern part of the route is line-of-sight with the Mt. Beacon transmitter site, while the southern part of the route is shielded by terrain. The northeastern part of the route, that on I-80, is shielded in part by tall city buildings. The western part of the route travels through city residential areas, through the MacArthur Tunnel, and through Golden Gate Park.

Route D - San Francisco Downtown: The San Francisco downtown route covers central parts of San Francisco, including both downtown city and nearby residential areas. All of Market Street is covered, which includes travel between tall buildings and under trolley power cables in the city area, and up commonly traveled mountain roads in the residential areas near Mt. Sutro and Twin Peaks. The route also includes travel through the Financial District, the low-rise Haight-Ashbury District, and up and down travel on the hills of California Street, which is shared in part with cable car traffic.

Route W - San Francisco Peninsula: The Peninsula route (western Bay Area) covers parts of the heavily traveled Route 101 and I-280 corridors, as well as the San Mateo County coastline. Travel on Highway 92 is included; this two-lane road is a popular commute route that connects residential Half Moon Bay with San Mateo. It winds up and down hills, and much of it is terrain-shielded to the Mt. Beacon transmitter site (and the other L-band transmitter sites, as well).

Route E - East Bay: The East Bay route includes travel on both the upper and lower decks of the Bay Bridge, which is the major link between San Francisco and Oakland. Travel is also included along Highway 24 and I-680. Highway 24 travel includes the Caldecott Tunnel, east of which is shielded from most Bay Area FM stations. Most of I-680 is also heavily terrain shielded. A large number of residential communities are located immediately adjacent to Highway 24, I-580, and I-680. The route includes travel immediately east of Oakland, along Highway 580.



## Electronic Industries Association

### "Long Path" Test Routes - Qualitative Information

**Route N - North Bay:** This route includes both line-of-sight (over the San Francisco and San Pablo Bays) and terrain-shielded areas. The part of the route that includes travel on I-80 and I-580 is nearly all line-of-sight to Mt. Beacon, while some travel on parts of Highways 101 and 37 is terrain-shielded. As with the Peninsula route, residential areas are adjacent along many parts of the route. Travel across two major bridges is included.

**Route S - South Bay:** This route is nearly all over flat terrain and on well-established roads and major commute highways. Line-of-sight conditions exist over most of the route; such propagation is all over water, consisting of almost the entire length of the San Francisco Bay. Travel also includes the heart of the Silicon Valley area, through Sunnyvale. As with the other routes, residential areas are adjacent, especially along the Lawrence Expressway. Travel across the Dumbarton Bridge is included in the route. The southernmost part of this route is sometimes considered to be a fringe coverage area for the FM stations on Mt. Beacon.

Some of the key qualitative characteristics of each route are summarized in the table below:

Qualitative Characteristic	Route					
	P	D	W	E	N	S
A. Some line-of-sight conditions exist	✓	✓	✓	✓	✓	✓
B. Terrain shielding conditions exist	✓	✓	✓	✓	✓	✓
C. Significant shielding by buildings	✓	✓		✓		✓
D. Vertical shielding (tunnels/wires)	✓	✓		✓		
E. Major over-water path	✓	✓		✓	✓	✓
F. Travel along waterfront areas	✓		✓	✓	✓	✓
G. Significant foliage along part of path	✓	✓	✓	✓		
H. Rural area(s) covered			✓		✓	
J. Primarily highway travel				✓		✓
K. Residential areas covered/directly adjacent	✓	✓	✓	✓	✓	✓
L. (More) residential areas optional			✓	✓	✓	✓
M. "Fringe" FM reception area			✓	✓		✓
N. Co-channel interferers (IBAC only) <sup>1</sup>	✓	✓	✓	✓	✓	✓
O. Adjacent-channel interferers (IBAC only) <sup>2</sup>	✓	✓			✓	

<sup>1</sup> KSEG, Sacramento, and KWAV, Monterey (both 96.9 MHz).

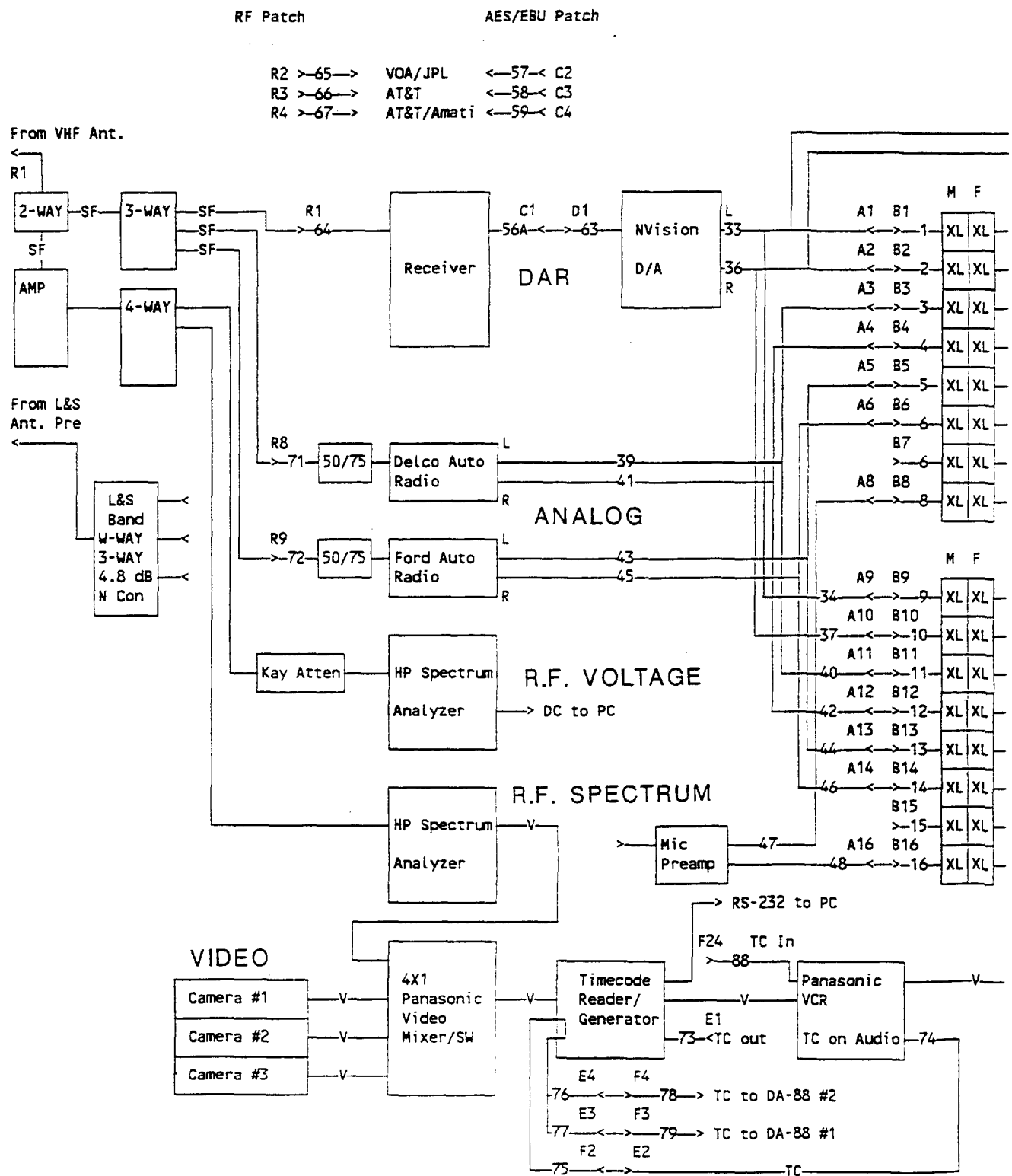
<sup>2</sup> KLLC, 97.3 MHz, San Francisco, and KOIT, 96.5 MHz, San Francisco.



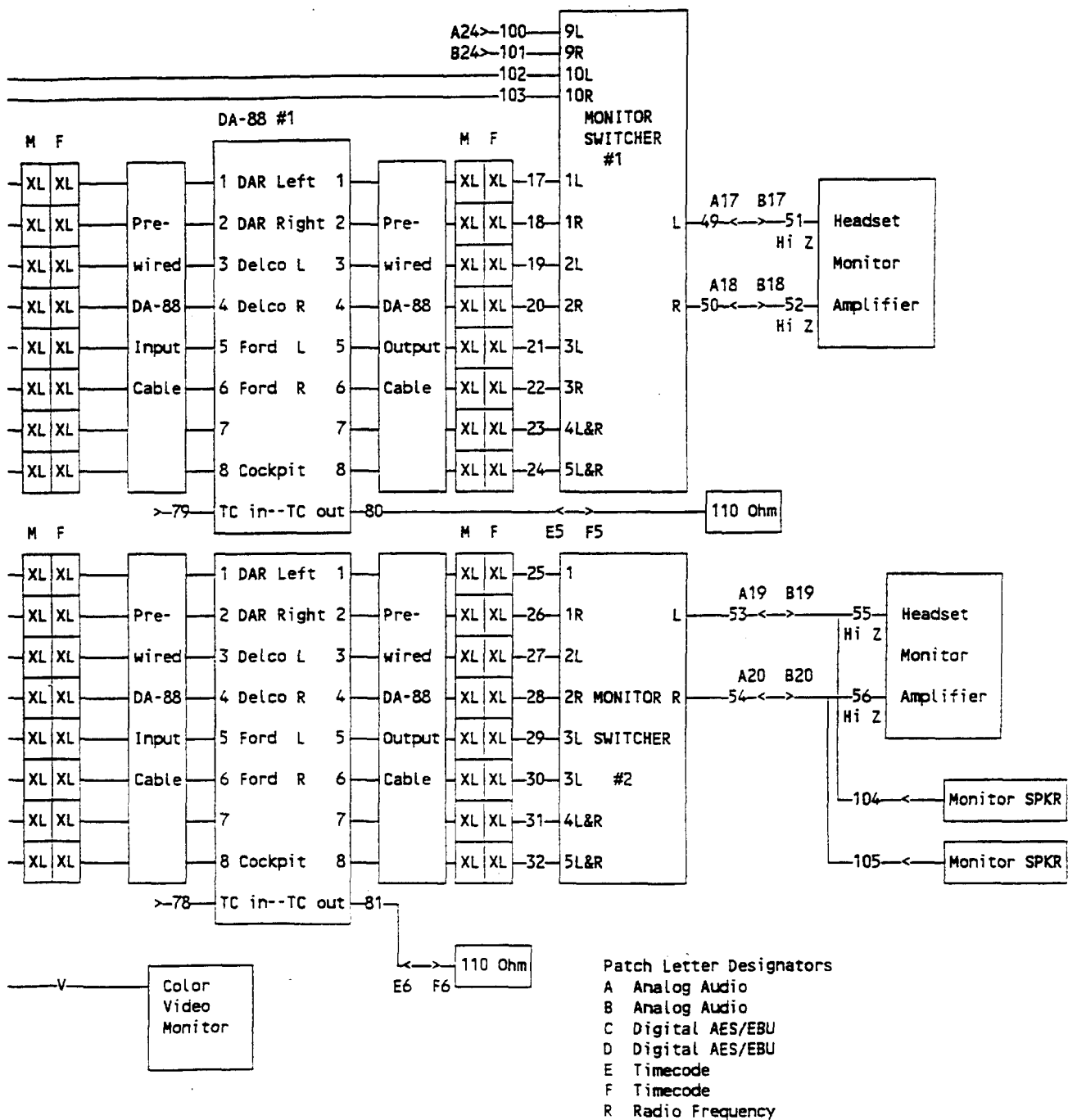
## **INDEX PAGE - APPENDIX C**

### **Field Test R.F. testbed data**

- C-1 As planned system block diagram, Digital Radio Test Laboratory, NASA Lewis Research Center; June, 1996.**
- C-2 R.F. Voltage measurement system, digitization and linearity. Digital Radio Test Laboratory, NASA Lewis Research Center; June, 1996.**
- C-3 As built R.F. block diagram (detail), gain & Loss. Hammett & Edison; November, 1996.**
- C-4 DAB Field Test Project Antenna Characterization Report, July 9, 1996, Ford Motor Company, COVER PAGE ONLY, full text available on request.**
- C-5 DAR Power calibration block Diagram and Table.**
- C-6 KEIA Transmitting antenna measurements.**



EIA-DAR FIELD TEST; TESTBED BLOCK DIAGRAM  
**R.F. SECTION (DETAIL)**



**EIA-DAR FIELD TEST; TESTBED BLOCK DIAGRAM  
AUDIO SECTION (DETAIL)**

# Digital Radio Test Laboratory

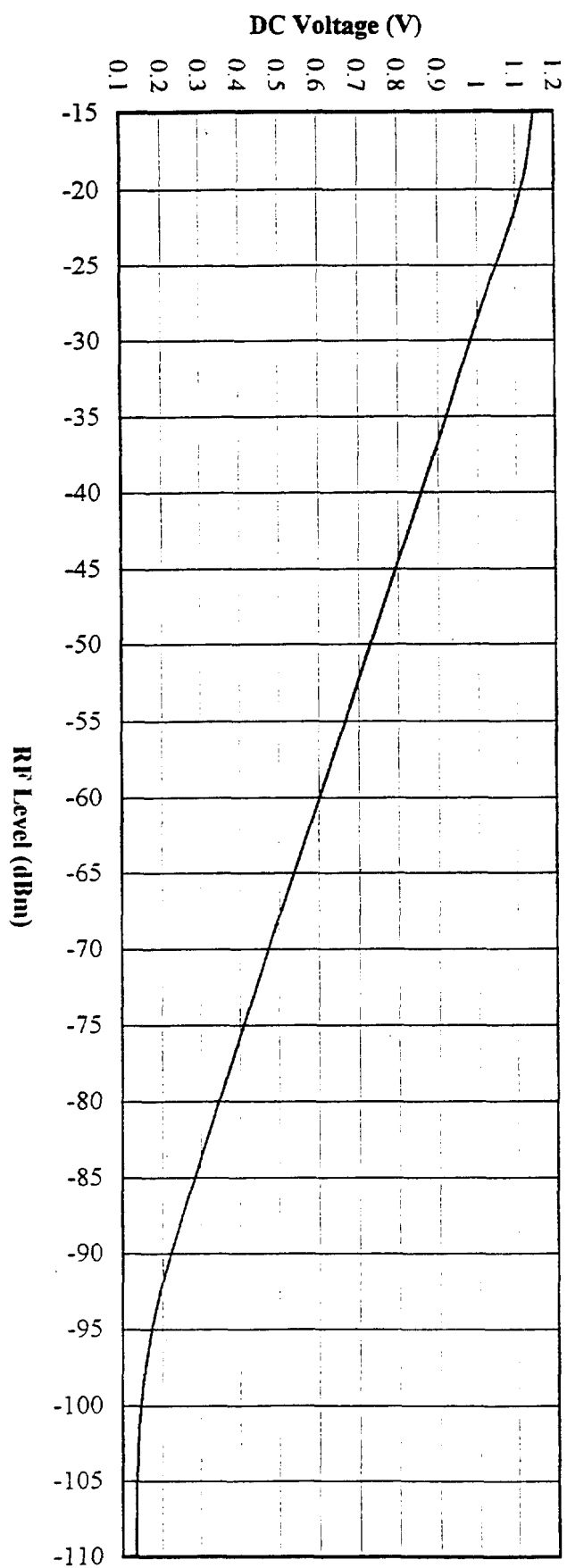
## **-30 dBm Ref AT&T**

-15	1.148	
-20	1.114	
-25	1.049	
-30	0.982	0.950
-35	0.921	
-40	0.857	0.822
-45	0.793	
-50	0.729	0.694
-55	0.666	
-60	0.601	0.566
-65	0.538	
-70	0.473	0.438
-75	0.410	
-80	0.346	0.315
-85	0.284	
-90	0.222	0.234
-95	0.173	
-100	0.146	
-105	0.136	
-110	0.133	

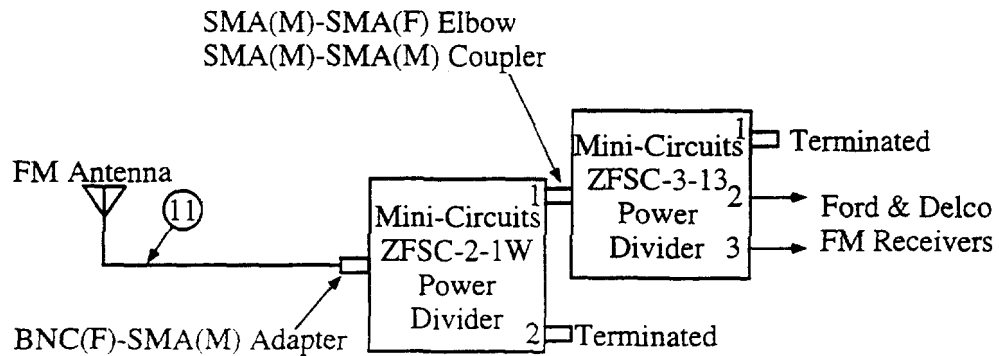
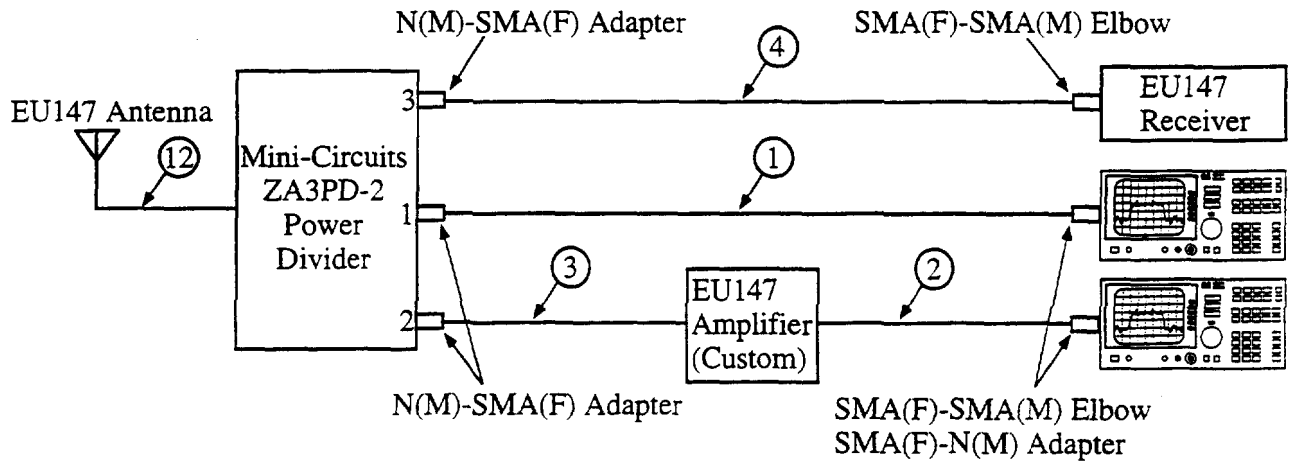


# Digital Radio Test Laboratory

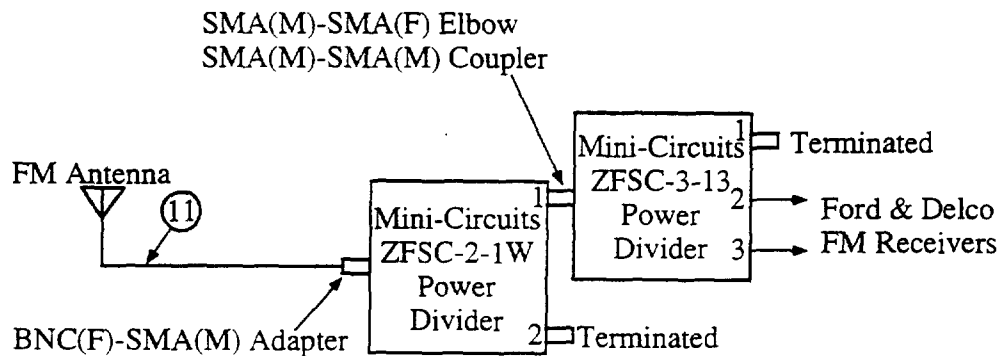
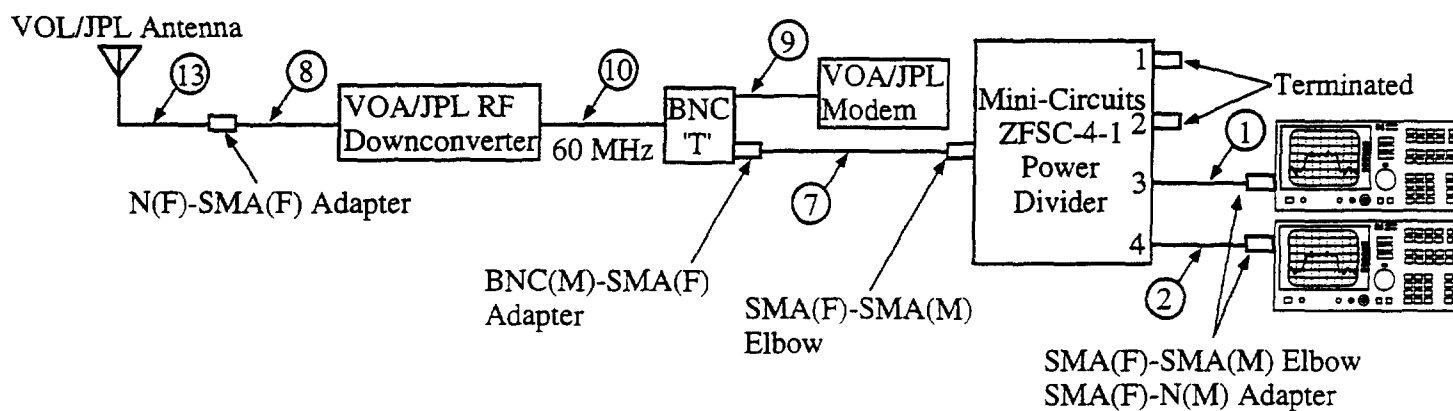
-30 dBm Reference



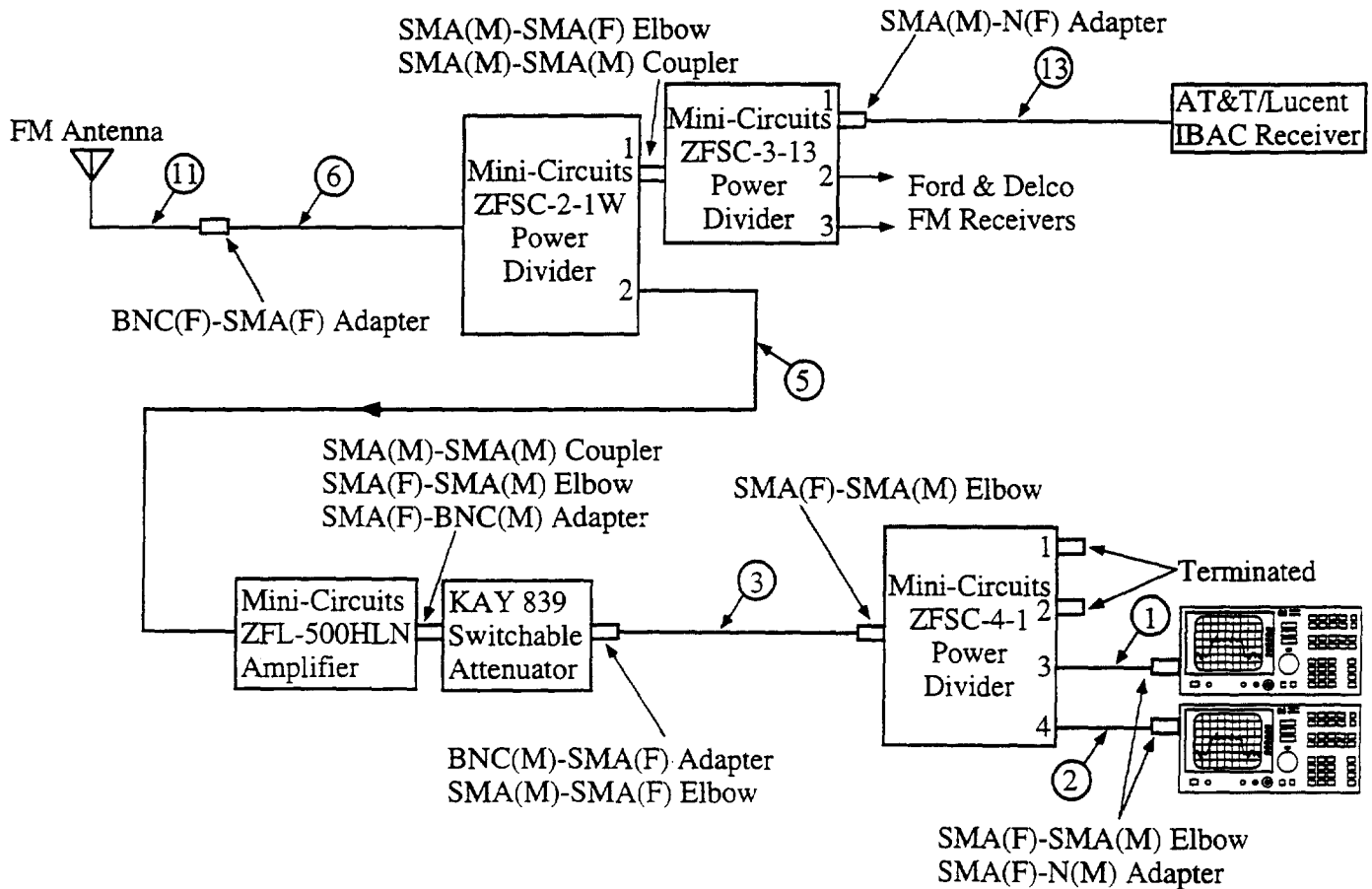
DAR RF Test Bed Configuration  
Eureka 147 System



DAR RF Test Bed Configuration  
VOA/JPL System



**DAR RF Test Bed Configuration  
AT&T/Lucent IBAC System**



## DAR RF Test Bed Components

## Cables

No.	Description	Length	Loss		
			VHF	L-Band	S-Band
1	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	36 in	0.45 dB	0.65 dB	—
2	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	36 in	0.45	0.65	—
3	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	12 in	0.19	0.26	—
4	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	18 in	—	0.36	—
5	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	18 in	0.26	—	—
6	QMI metal shielded semi-rigid coax SMA(M)-SMA(M)	18 in	0.26	—	—
7	M17/60-RG142 MIL-C-17G 12814 THERMAX SMA(M)-SMA(M)	36 in	0.09	—	—
8	SWC 507-142B RG142B/U SMA(M)-SMA(M)	11.5 in	—	—	0.24
9	RG59/U type CL2 22 AWG BNC(M)-BNC(M)	19 in	0.04	—	—
10	VOA/JPL coax signal cable BNC(M)-SMA(M)	15.5 in	0.03	—	—
11	Tandy Wire & Cable Type RG-58/U BNC(M)-BNC(M)	16 ft	0.72	—	—
12	Belden Type 9914 RG-8 N(M)-N(M)	8 ft	—	0.53	—
13	Belden Type 9914 RG-8 N(M)-N(M)	25 ft	0.42	—	2.05

## Devices

Description		Gain/Loss
Mini-Circuits ZFL-500HLN Amplifier		+ 20.7 dB (VHF)
Mini-Circuits ZFSC-2-1W Power Divider	Port 1	-3.24
	Port 2	-3.25
Mini-Circuits ZFSC-3-13 Power Divider	Port 1	-5.13
	Port 2	-5.12*
	Port 3	-5.13*
Mini-Circuits ZFSC-4-1 Power Divider	Port 3	-6.51
	Port 4	-6.52
EU147 Custom Amplifier		+ 32.3 (L-Band)
Mini-Circuits ZA3PD-2 Power Divider	Port 1	-4.87
	Port 2	-4.99
	Port 3	-5.04

\* Provided for information only. Used to feed Delco and Ford FM receivers.



**HAMMETT & EDISON, INC.**  
CONSULTING ENGINEERS  
SAN FRANCISCO

961209  
Figure 4

## **DAB FIELD TEST PROJECT ANTENNA CHARACTERIZATION REPORT**

*submitted to:*

**NRSC/EIA/NAB Field Test Task Force**

July 9, 1996

*prepared by:*

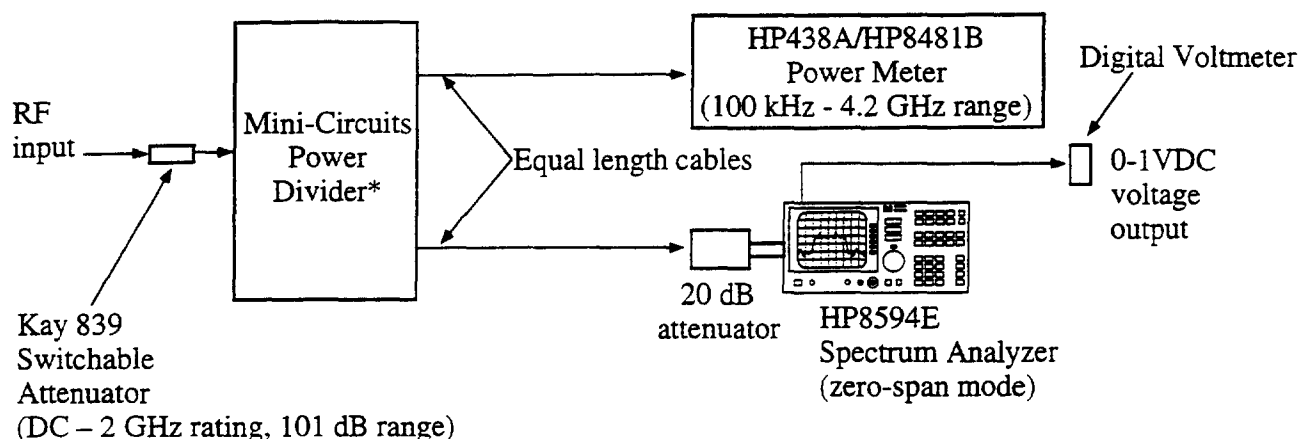
Ford Motor Company  
Audio Systems Engineering  
Michael Chrysochoos  
Richard Zerod

(313) 594-3684  
(313) 323-2526

mchrysoc@e-mail.com

**NOTE: Copies of this report are available from Ralph Justus at EIA.**

# DAR Power Calibration Block Diagram



## RF Input Characteristics

System	Frequency	Source
AT&T/Lucent IBAC	96.9 MHz	Output of system rack through IPA
Eureka 147	1468	EU147 Itis/Telefunken encoder/modulator
VOA/JPL	60	Modem IF output (using VOA/JPL S-band upconverter as source; internal generator mode)

\* Mini-circuits Type ZFSC-2-1W power divider used for AT&T/Lucent and VOA/JPL;  
Type ZA3PD-2 power divider used for Eureka 147, with unused output terminated.

### DAR Power Calculation Collected Data

Attenuator Setting	AT&T/Lucent IBAC			Eureka 147			VOA/JPL		
	Power-meter Reading	Zero-Span Analyzer	DC voltage	Power-meter Reading	Zero-Span Analyzer	DC voltage	Power-meter Reading	Zero-Span Analyzer	DC voltage
0 dB	-12.6 dBm	-33 dBm	0.921 V	-7.04 dBm	-37 dBm	0.819 V			
3	-15.6	-36	0.882	-10.1	-40	0.780			
6	-18.6	-39	0.844	-13.1	-43	0.742			
9	-21.6	-43	0.803	-16.0	-46	0.705			
12	-24.5	-46	0.766	-19.4	-49	0.663			
15	-27.4	-49	0.728	-22.2	-52	0.627	-9.55 dBm	-31 dBm	0.943 V
18	-30.3	-52	0.690	-25.1	-55	0.588	-12.6	-34	0.905
20	-31.9	54	0.664				-15.6	-37	0.867
21				-27.9	-58	0.553	-17.6	-39	0.833
24				-30.8	-61	0.515	-18.6	-40	0.827
27				-34.0	-64	0.474	-21.6	-43	0.789
30	-37.8	-64	0.536	-36.7	-67	0.435	-24.4	-46	0.750
40		-74	0.408		-70	0.316	-27.3	-49	0.712
50		-84	0.283		-80	0.232		-59	0.583
60		-94	0.172		-90	0.208		-69	0.455
70		-97	0.119		-90	0.205		-79	0.328
80								-89	0.210
								-95	0.131

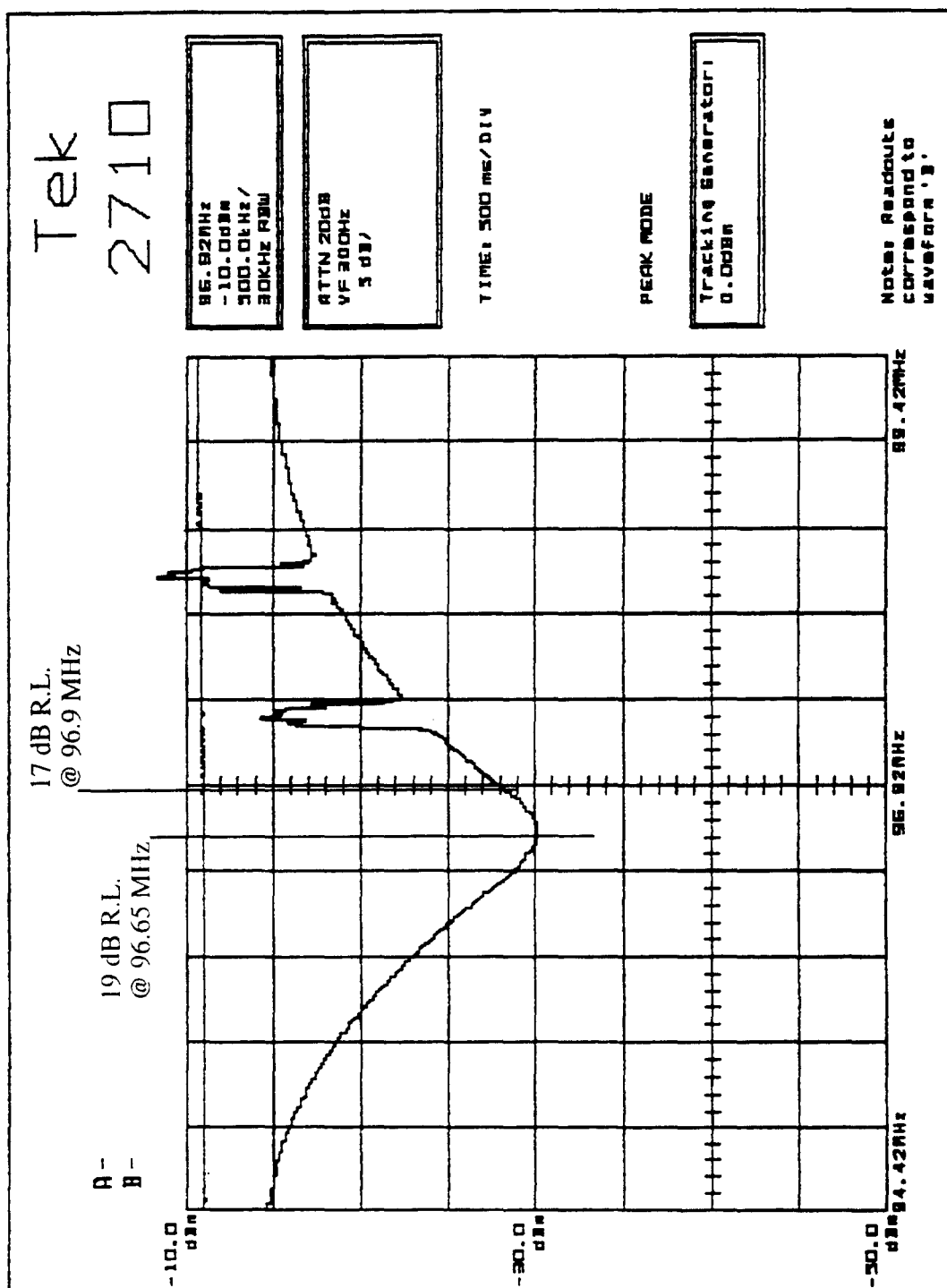
#### Notes

1. Power meter readings are not adjusted to reflect the 20 dB attenuator in the zero span spectrum analyzer path. Subtract 20 dB from power meter readings to equalize.
2. Power meter readings become inaccurate/unstable for levels below about -25 dBm, as reported above.
3. Zero-span spectrum analyzer readings become inaccurate/unstable for levels below about -90 dBm, as reported above.



# Swept Return Loss Measurement of KEIA Transmitting Antenna

Measurement conducted on November 11, 1996 by William Ruck  
using Tektronix Model 2710 Spectrum Analyzer  
and custom directional coupler



961214  
Figure 1